CLAIMS

1. A material for the storage of hydrogen comprising : single wall carbon nanotubes, wherein a majority of diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nm, and the average length of the single wall carbon nanotubes is less than or equal to 1000 nm.

2. The material of claim 1 wherein the average length is less than or equal to 500 nm.

3. The material of claim 1 wherein the average length is less than or equal to 200 nm.

4. The material of claim 1 wherein the majority of the diameters of the single wall carbon nanotubes range from 0.4 to 0.8 nanometers.

5. The material of claim 4 wherein the average length is less than or equal to 500.

6. The material of claim 1 wherein greater than 75 percent of the diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nanometers.

7. The material of claim 1 wherein greater than 75 percent of the diameters of the single wall carbon nanotubes range from 0.4 to 0.8 nanometers.

8. The material of claim 1 wherein the single wall carbon nanotubes are in a plurality of bundles.

9. The material of claim 8 wherein each bundle comprises at least 7 single wall carbon nanotubes.

10. The material of claim 8 wherein each bundle comprises at least 100 single wall carbon nanotubes.

11. The material of claim 8 wherein the distance between the single wall carbon nanotubes in the bundles is between from 0.3 to 0.4 nm.

12. The material of claim 1 wherein the heat (-ΔH) of hydrogen adsorption of the material is within the range from 4 kcal/mole H_2 to 8 kcal/mole H_2.

13. The material of claim 1 wherein the heat (-ΔH) of hydrogen adsorption of the material is within the range from 5 kcal/mole H_2 to 7.5 kcal/mole H_2.

14. The material of claim 1 wherein the heat (-ΔH) of hydrogen adsorption of the material is within the range from 5.3 kcal/mole H_2 to 7 kcal/mole H_2.

15. A process for the storage and release of hydrogen in a vessel comprising single wall carbon nanotubes wherein the majority of diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nm, and the average length of the single wall carbon nanotubes is less than or equal to 1000 nm, wherein said process is selected from the group consisting of:
pressure swing adsorption, temperature swing adsorption or pressure and temperature swing adsorption.

16. A process for the storage and release of hydrogen comprising the steps of:

providing a vessel comprising single wall carbon nanotubes wherein the majority of the diameters of the single wall carbon nanotubes of the assembly range from 0.4 to 1.0 nm, and the average length of the single wall carbon nanotubes is less than or equal to 1000 nm;

introducing hydrogen into the vessel while increasing the pressure to a sorption pressure; and

discharging the hydrogen from the vessel by decreasing the pressure from the sorption pressure to a desorption pressure.

17. The process of claim 16 further comprising the steps of:

cooling the single wall carbon nanotubes to a sorption temperature while performing said introducing step; and

heating the single wall carbon nanotubes from a sorption temperature to a desorption temperature while performing said discharging step.

18. The process of claim 16 further comprising the steps of:

cooling the single wall carbon nanotubes while performing said introducing step.

heating the single wall carbon nanotubes while performing said discharging step.

19. The process of claim 16 wherein the desorption pressure is in the range from 1 to 200 psia, and sorption pressure is in the range from 50 to 5000 psia.

20. The process of claim 16 wherein the desorption pressure is in the range from 14 to 50 psia, and sorption pressure is in the range from 100 to 1000 psia.

21. The process of claim 17 wherein the desorption temperature is in the range from 273 to 473 K and the sorption temperature is in the range from 243 to 353 K.

22. The process of claim 17 wherein the desorption temperature is in the range from 293 to 363 K and the sorption temperature is in the range from 273 to 323 K.

23. The process of claim 17 wherein the desorption pressure is in the range from 14 to 50 psia, the sorption pressure is in the range from 200 to 1000 psia, the desorption temperature is in the range from 323 to 363 K, and the sorption temperature is in the range from 273 to 323 K.

24. A process for the storage and release of hydrogen comprising the steps of:

providing a vessel comprising single wall carbon nanotubes wherein the majority of the diameters of the single wall carbon nanotubes of the assembly range from 0.4 to 1.0 nm, and the average length of the single wall carbon nanotubes is less than or equal to 1000 nm;

introducing hydrogen into the vessel while decreasing the temperature to a sorption temperature, and

discharging the hydrogen from the vessel by increasing the temperature from the sorption temperature to a desorption temperature.

25. A material for the storage of hydrogen comprising : single wall carbon nanotubes, wherein a majority of diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nm, and the heat (-ΔH) of hydrogen adsorption of the material is within the range from 4 kcal/mole H_2 to 8 kcal/mole H_2.

26. The material of claim 25 wherein the heat (-ΔH) of hydrogen adsorption of the material is within the range from 5 kcal/mole H_2 to 7.5 kcal/mole H_2.

27. The material of claim 25 the heat (-ΔH) of hydrogen adsorption of the material is within the range from 5.3 kcal/mole H_2 to 7 kcal/mole H_2.

28. The material of claim 26 wherein the average length is less than or equal to 500 nm.

29. The material of claim 27 wherein the average length is less than or equal to 200 nm.

30. The material of claim 25 wherein the majority of the diameters of the single wall carbon nanotubes range from 0.4 to 0.8 nanometers.

31. The material of claim 25 wherein greater than 75 percent of the diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nanometers.

32. The material of claim 25 wherein greater than 75 percent of the diameters of the single wall carbon nanotubes range from 0.4 to 0.8 nanometers.

33. The material of claim 25 wherein the single wall carbon nanotubes are in a plurality of bundles.

34. The material of claim 33 wherein each bundle comprises at least 7 single wall carbon nanotubes.

35. The material of claim 33 wherein each bundle comprises at least 100 single wall carbon nanotubes.

36. The material of claim 33 wherein the distance between the single wall carbon nanotubes in the bundles is between from 0.3 to 0.4 nm.

37. A process for the storage and release of hydrogen in a vessel comprising single wall carbon nanotubes wherein the majority of the diameters of the single wall carbon nanotubes range from 0.4 to 1.0 nm, and the heat ($-\Delta H$) of hydrogen adsorption of the single wall carbon nanotubes is within the range from 4 kcal/mole H_2 to 8 kcal/mole H_2, wherein said process is selected from the group consisting of:

pressure swing adsorption, temperature swing adsorption or pressure and temperature swing adsorption.

38. A process for the storage of hydrogen comprising the steps of:

providing a vessel comprising single wall carbon nanotubes wherein the majority of the diameters of the single wall carbon nanotubes of the assembly range from 0.4 to 1.0 nm, and the heat ($-\Delta H$) of hydrogen adsorption of the single wall carbon nanotubes is within the range from 4 kcal/mole H_2 to 8 kcal/mole H_2;

introducing hydrogen into the vessel while increasing the pressure to a sorption pressure; and

discharging the hydrogen from the vessel by decreasing the pressure from the sorption pressure to a desorption pressure.

39. The process of claim 38 further comprising the steps of:

cooling the single wall carbon nanotubes to a sorption temperature while performing said introducing step; and

heating the single wall carbon nanotubes from the sorption temperature to a desorption temperature while performing said discharging step.

40. The process of claim 38 further comprising the steps of:

cooling the single wall carbon nanotubes while performing said introducing step.

heating the single wall carbon nanotubes while performing said discharging step.

41. The process of claim 38 wherein the desorption pressure is in the range from 1 to 200 psia, and sorption pressure is in the range from 50 to 5000 psia.

42. The process of claim 38 wherein the desorption pressure is in the range from 14 to 50 psia, and sorption pressure is in the range from 100 to 1000 psia.

43. The process of claim 39 wherein the desorption temperature is in the range from 273 to 473 K and the sorption temperature is in the range from 243 to 353 K.

44. The process of claim 39 wherein the desorption temperature is in the range from 293 to 363 K and the sorption temperature is in the range from 273 to 323 K.

45. The process of claim 39 wherein the desorption pressure is in the range from 14 to 50 psia, the sorption pressure is in the range from 200 to 1000 psia, the desorption temperature is in the range from 323 to 363 K, and the sorption temperature is in the range from 273 to 323 K.

46. The process of claim 38, wherein said single wall carbon nanotubes have an average length less than or equal to 1000 nm.

47. A process for the storage and release of hydrogen comprising the steps of:

providing a vessel housing single wall carbon nanotubes wherein the majority of the diameters of the individual nanotubes of the assembly range from 0.4 to 1.0 nm, and the heat ($-\Delta H$) of hydrogen adsorption of the single wall carbon nanotubes is within the range from 4 kcal/mole H_2 to 8 kcal/mole H_2, and

introducing hydrogen into the vessel while decreasing the temperature to a sorption temperature, and

discharging the hydrogen from the vessel by decreasing the pressure from the sorption pressure to a desorption pressure.